

ERROR MAGNETIC FIELD WORKSHOP

DISCUSSION

OCTOBER 31 – NOVEMBER 1, 2003

**Albuquerque
New Mexico**

QUESTIONS & ISSUES

- **Correction coils should be designed to match the “plasma response,” not necessarily the expected error field (Boozer)**
 - We all know this – for example, we ignore “error fields” of the opposite helicity
- **Locked Modes? What is the response of a rotating plasma to an external error field?**
 - Does it depend on the details of the error field?
 - How do you measure? How do you calculate?
 - What happens if you don’t have $q = 1$ surface? $q = 2$ surface?
- **What is the correct sideband weighting for locked modes?**
 - Suggest that derived by COMPAS, since they have generated fields with most definitive harmonic mix
 - Other experiments do not uniquely measure the sidebands of the “intrinsic” error field

QUESTIONS & ISSUES (continued)

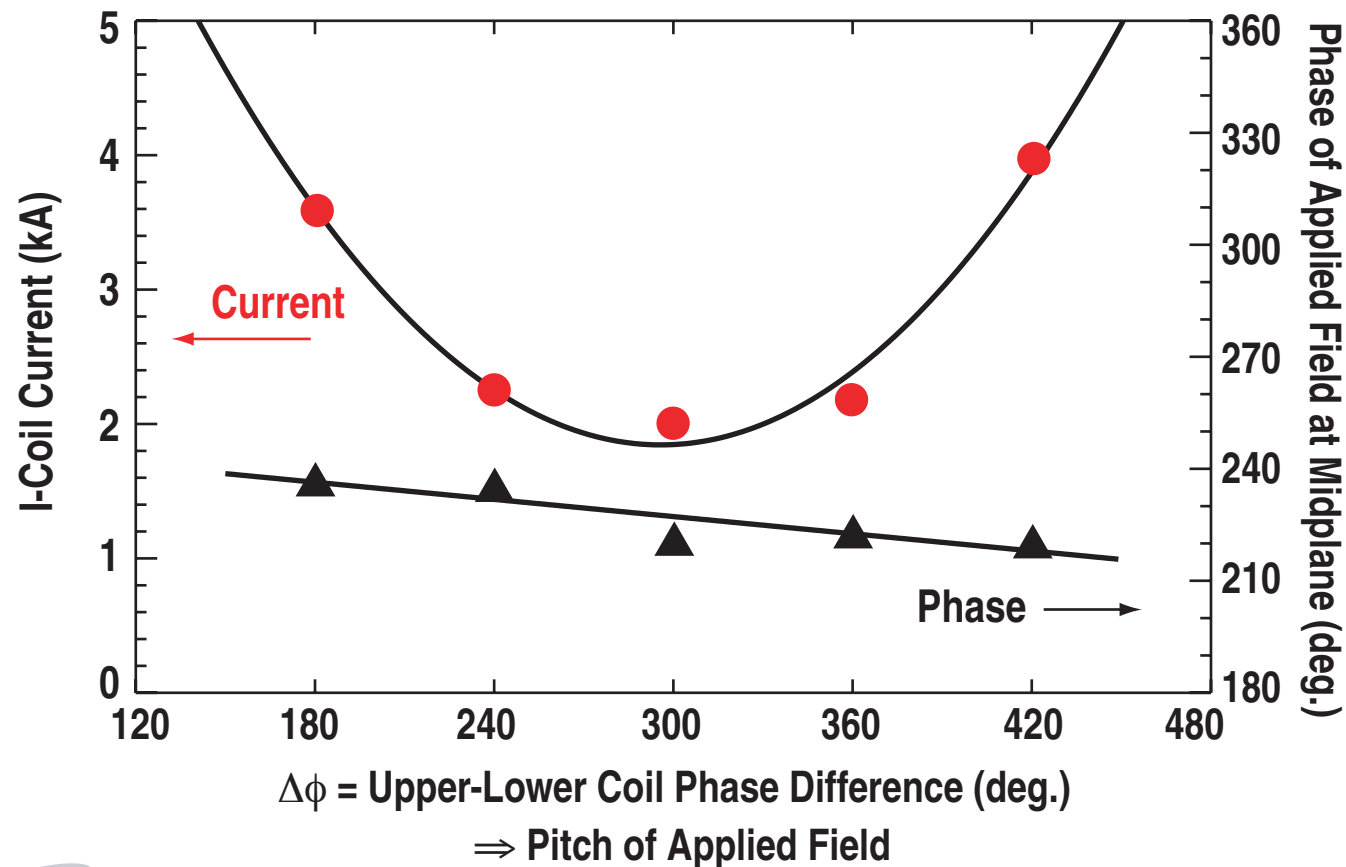
- **Resistive Wall Mode: Is there a minimum error field magnitude required (threshold) to obtain "error field amplification?"**
 - Garofalo: good error field correction – no RWM, rotation above critical; better error field correction – still no RWM but faster rotation
 - What is the drag on the plasma as the error field goes to zero? – by the wall with no error field?
- **Stochastic fields: Why does the electron temperature not decrease significantly when the flux surfaces are broken?**
 - Does the lack of a change in the temperature profiles with $n=3$ stochastic layer imply that the difference between Z_{ts} & Z_{efit} cannot be attributed to loss of closed flux surfaces?

ERROR CORRECTION COILS SHOULD BE DESIGNED TO MATCH the PLASMA RESPONSE, the PERTURBED PLASMA

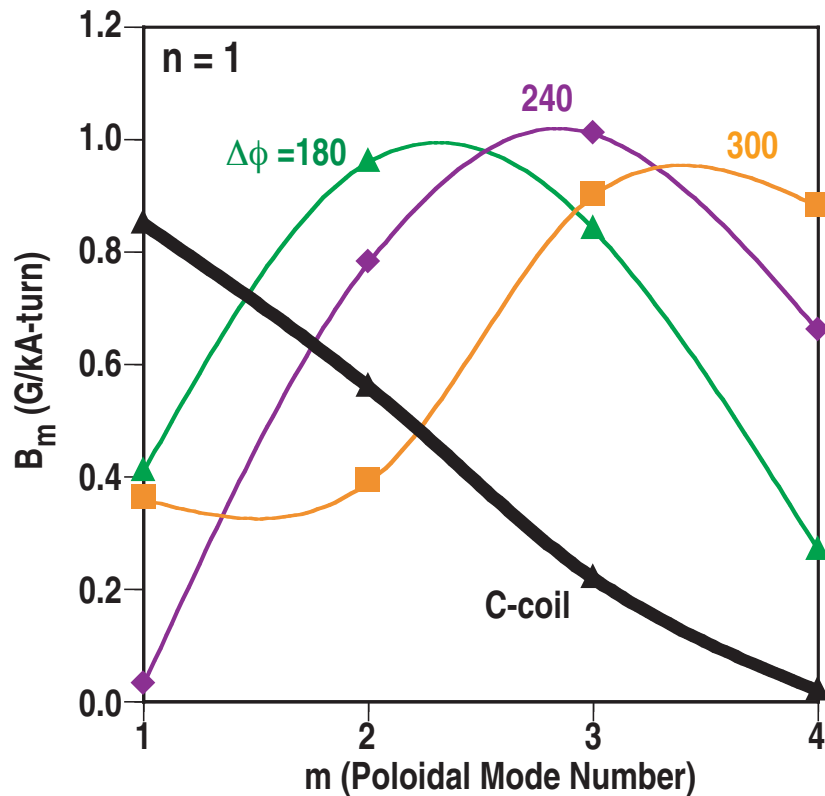
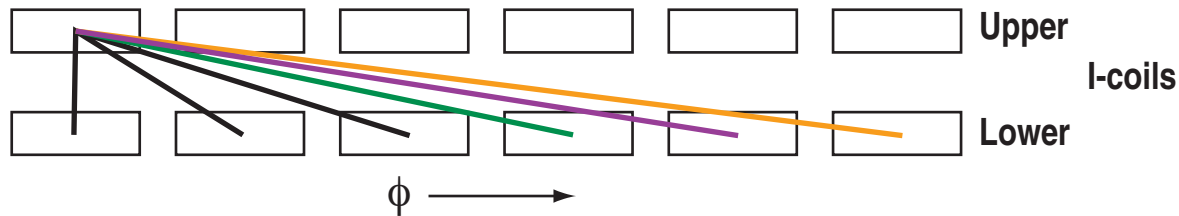
- Experiments with incorrect helicity generates no measurable plasma response
 - TEXT Ergodic Magnetic Limiter Experiment
 - All of us ignore the “wrong” helicity in error field correction
- Design of RWM coils are “optimized” according to the measured and calculated plasma perturbation
 - See experiments on DIII-D
- Error field correction experiments cannot unambiguously determine the intrinsic error field
 - What is the intrinsic error field deduced from (1) locked modes, (2) RWM & C-coil, (3) RWM & I-coil, (4) RWM & I-coil with different m (toroidal phase)?
 - My conjecture: experiments “measure” the component of the error field resonate with the “plasma response”

ERROR FIELD COMPENSATION IS MOST EFFICIENT WHEN I-COIL FIELD MATCHES RWM STRUCTURE

- Correction field pitch scanned by varying upper/lower coil connections
- Correction field amplitude and phase determined by feedback control
- Constant phase is consistent with correcting a fixed error field



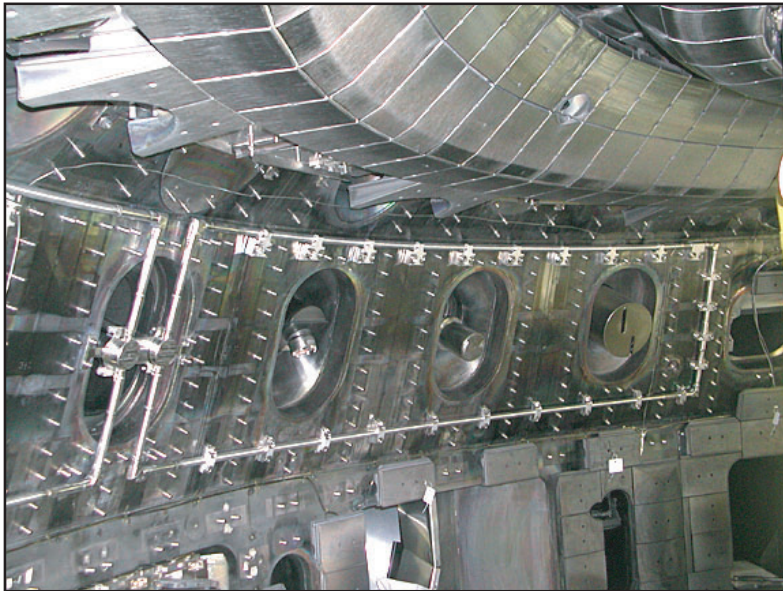
I-COIL CONNECTIONS ALLOW A WIDE RANGE OF (m,n) SPECTRA



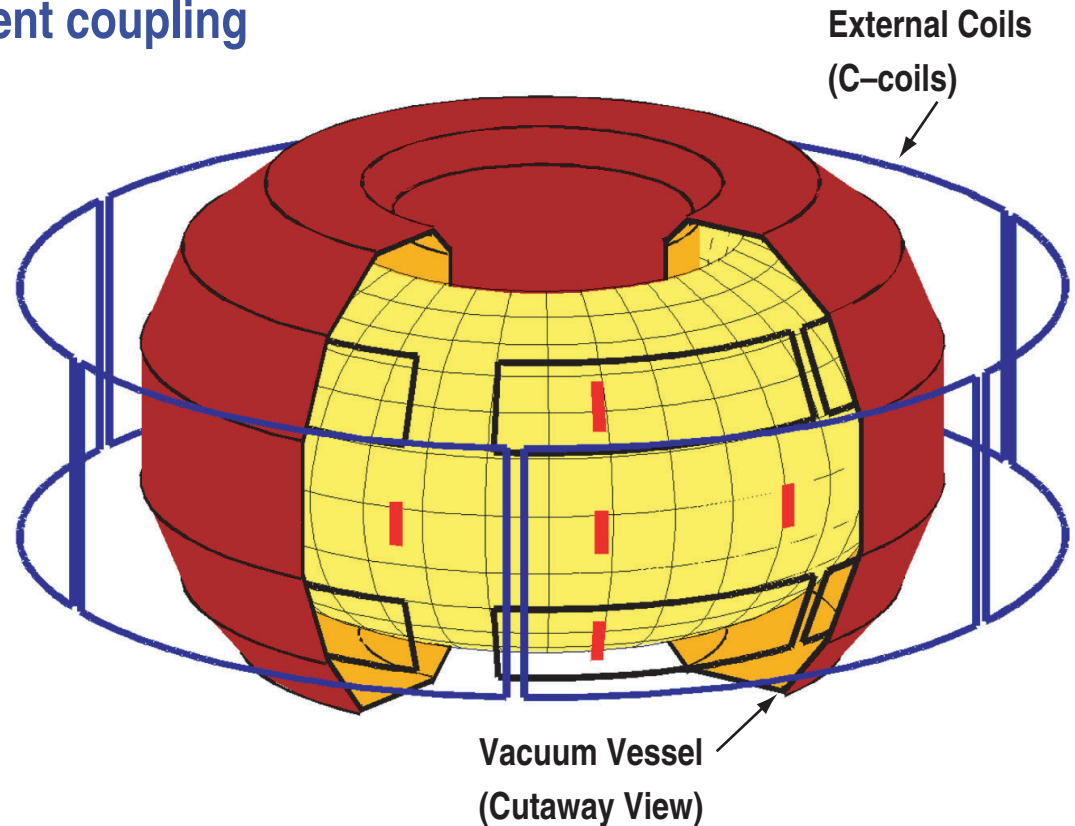
- Toroidal mode number: $0 \leq n \leq 3$
- Antisymmetric pairs ($n = \text{odd}$) used for most experiments
- Poloidal mode number: $0 \leq m \leq 4$
- 240 degree upper-lower phase difference used for most experiments

NEW INTERNAL CONTROL COILS ARE AN EFFECTIVE TOOL FOR PURSUING ACTIVE AND PASSIVE STABILIZATION OF THE RWM

- Inside vacuum vessel: Faster time response for feedback control
- Closer to plasma: more efficient coupling



- 12 “picture-frame” coils
- Single-turn, water-cooled
- 7 kA max. rated current
- Protected by graphite tiles



G.L. Jackson, G01.003